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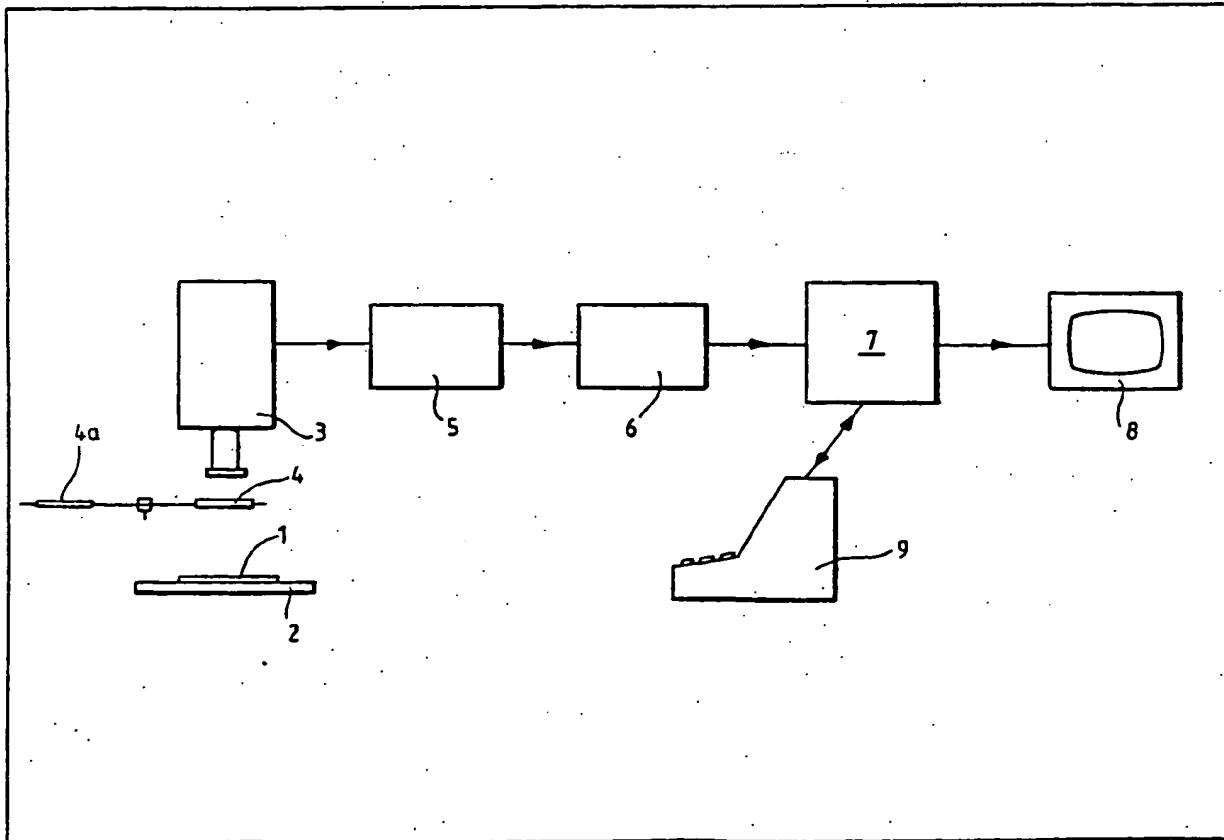
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(54) Producing patterns

(57) An electronic visual image sensor

(3) scans a representation (1) of a desired design and provides a sequence of intensity signals for each of a multiplicity of points of the representation. The intensity signals are converted (6) to digital form and (for example on a colour monitor 8 or a printer displayed). By way of example, an embroidery pattern may be produced from, say, a photograph using this apparatus; the display being a colour monitor which may then be used to adjust colour balance or a coded equivalent of the actual pattern.



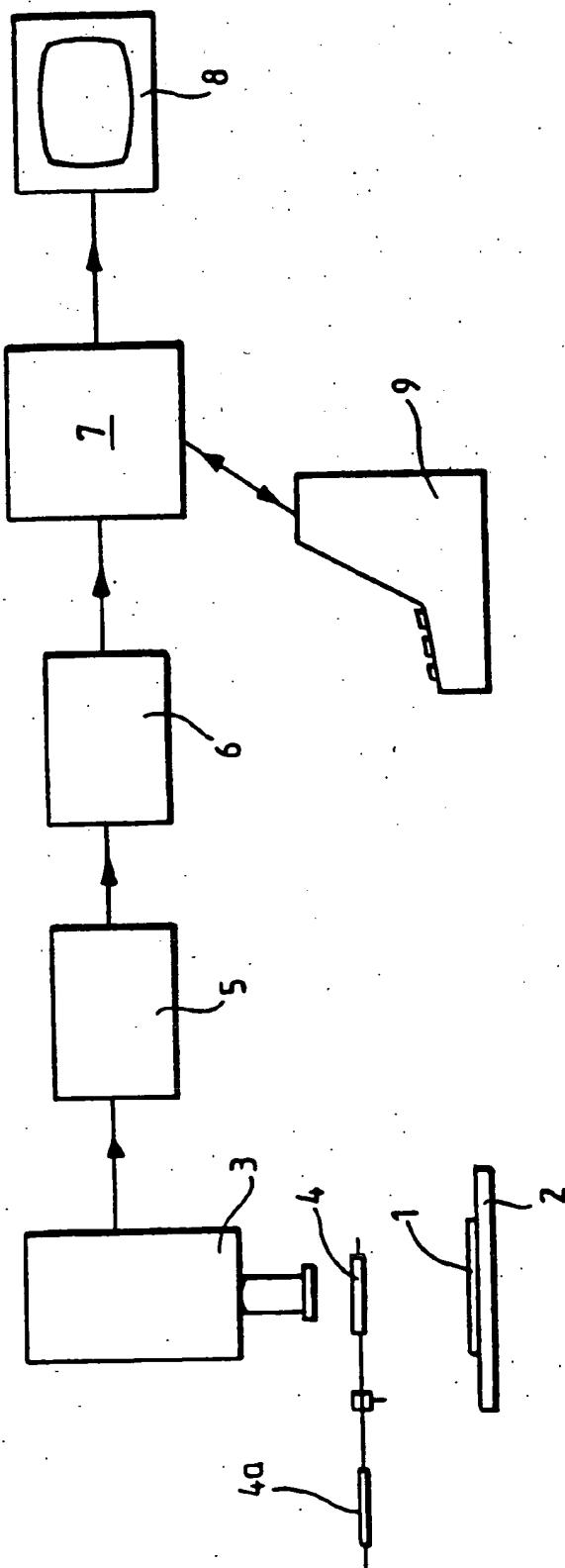
The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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SPECIFICATION**Production of patterns**

This invention is concerned with the production of patterns, upon the basis of which designs or other representations may be made. It is particularly concerned with the production of patterns for what may generally be termed "mosaic" designs, by which is meant, in the broadest possible sense, designs and

representations formed by combining a plurality of discrete units of differing colour and/or differing texture or finish. The invention also includes the production of such designs from patterns produced by my method.

The prior art methods of producing such patterns are typified by those used in the field of embroidery. A typical embroidery pattern, whether for domestic embroidery by hand or for programming the operation of a machine, consists of a diagram of squares, each square representing one stitch space and carrying an indication of what colour is to be used for the stitch or that no stitch is required. Such diagrams are prepared manually from coloured representations of the desired finished design and their preparation is a time-consuming and specialised task. If the diagram is subsequently to be used for programming the operation of a machine, then the setting up of the machine is itself a major task, entailing for example the adjusting of the stitch-producing cams individually to correspond with the instruction contained in each square of the diagram.

Similar considerations apply in the preparation of patterns for other domestic or industrial design-producing operations, for example for counted-thread, tufting, rug-making, crocheting, knitting and other handicraft work and in the manufacture of carpets and wallpaper and the creation of architectural mosaics for floors, walls or pavements. More recently, similar methods have been used in the preparation of "shimmering" coloured decorative displays in which the mosaic unit is a suspended shiny disc.

Because the production of patterns by prior art methods is so time-consuming and specialised a task, it is generally uneconomical to produce patterns to individual order or for short production runs. There is therefore clearly a need for a device and method for producing patterns more quickly and relatively cheaply. Such a device and method are provided by my invention.

According to my invention, apparatus for the production of patterns comprises an electronic visual image sensor for scanning a representation of a desired design and providing a sequence of intensity signals for each of a multiplicity of points of the representation, means for converting the intensity signals to digital form and means for displaying the resulting sequence of digital signals.

The image sensor preferably scans the representation in turn through each of say three primary colour filters, for example red, cyan and

blue, so that the intensity of each point is recorded as sensed in each colour. A gamma correction unit is preferably included in the circuit following the image sensor so as to balance the responses of the different colour channels. As the sensor

responds at a different "speed" to the light passing through the different filters, it is desirable that such balancing be effected in order to reproduce accurately the colours scanned.

The purpose of the apparatus according to my invention is, of course, to reproduce the original representation in the form of a corresponding pattern, from which the ultimately desired representation, e.g. embroidery or mosaic picture, may be made. My apparatus therefore includes

means for displaying the sequence of digital signals produced by the digital converter. Thus the desired pattern may be displayed in hard copy form as for example in the form of a conventional embroidery or knitting pattern. Alternatively, the desired pattern may be displayed transiently as on a colour video monitor or on a visual display unit (VDU) or graphics tablet. In either case, the sequence of digital signals may be recorded and stored for further use.

Advantageously, the apparatus according to my invention includes means for displaying the sequence of digital signals simultaneously with the scanning so that, before any permanent display in the form of a printed pattern is produced and/or before the signals are recorded and stored, desired corrections or adjustments to the image may be made. Thus a VDU may be employed to display the image at the time of scanning to enable the size of the image to be modified or the colour balance adjusted.

The apparatus preferably includes a computer or similar processor to control the recording of the signals and any display derived from the signals. The computer may also control a VDU for effecting correction or alteration of the signals.

A computer, if used, may also control the subsequent production of the desired design from the patterns produced. Thus, for example, the computer may control the operation of one or more embroidery, knitting or printing machines in direct response to the instructions contained in the pattern, for example in response to control from a program or signals recorded as above.

The computer preferably also has access to memory devices such as pre-recorded tape or disc programs, capable of matching the digital signals with the coloured elements, e.g. threads or thread combinations, available for use. The computer may thereby select threads or other mosaic

elements to be used when preparing the desired representation from the pattern. Thus, for example, in preparing an embroidery pattern, the computer may select the colours of threads to be used from a limited range, say from 32 differently coloured threads, in order to produce the visually best match to the original representation or design.

The computer may also be used to determine, from the pattern, the total numbers of the

differently coloured elements, for example threads or mosaic tiles, required to produce each or a number of representations. This in turn, on the commercial scale, assists the control of ordering and stock levels.

5 The invention will now be further described with reference to the accompanying drawing, which illustrates schematically one embodiment of the apparatus according to my invention.

10 Referring to the drawing, a design or representation, for example a colour photograph 1, is rigidly supported upon a rostrum 2. The photograph 1 is scanned by a video or television camera 3, which views the photograph 1 in turn through filters 4, 4a of a rotatable set. The set is of three filters corresponding to three primary colours, for example red, cyan and blue. The scanning provides intensity signals in each colour channel for each of a multiplicity of points arranged in "lines", with appropriate line synchronising signals. Each colour scan is made in turn and the sequence of colour scans is repeated several times (for example to give four scans in each colour) and the signals averaged or summed.

25 The signals from camera 3 are fed to a gamma correction circuit 5 which compensates for the "speed" of the camera 3 being different in the different colours so that intensity signals can be adjusted to provide a correct balance between the colours. The corrected signals are then fed to a binary converter 6 which may, if desired, have a memory store. The coded signals are fed in the form of "bytes", each comprising a plurality of "bits" ("1" or "0" pulses) forming a binary number 30 or pixel corresponding to the intensity level of one unit area of the representation, which will become a "mosaic" unit, e.g. a stitch.

35 The binary signals from the converter 6 are then applied to a computer 7, which records the video information signal constituted by the input from the converter 6, for example on a floppy disc or other recording medium, such as magnetic tape.

40 The image to be recorded may be displayed simultaneously or prior to recording on a colour monitor 8 and on a VDU 9 with keyboard, by means of which the data displayed may be corrected or amended. Alternative or additional displays may be obtained using a graphics tablet 45 and/or a printer. In particular, a print-out on paper may be obtained and may serve as a direct equivalent, suitably coded, of the paper pattern conventionally used in embroidery, knitting, rug-making, mosaic-making and other similar crafts and industrial operations.

45 The computer 7 itself, or a further computer, may be operated by the program of signals derived from the original representation, for example using the above-mentioned floppy disc or magnetic tape, to control the operation of say an embroidery or knitting machine direct. That is, the instructions from the program may operate stitching needles in turn, for example via magnetic actuators, and select an appropriate thread or combination of threads for each stitch. The machine control

50 computer advantageously it programmed to use a memory keyed to the recognition of colour by comparing the relative signal levels of the three colour channels and matching the result to the stored corresponding information of each of a plurality of available colours or threads or combinations of threads, to gate appropriate thread feed signals.

55 Thus, by using the apparatus according to my invention, it is possible if desired to program a computer-controlled embroidery machine to carry out flexibly, any of a number of patterns simply by changing floppy discs or tapes, without any of the laborious resetting of mechanical needle or thread feed control elements, cams and the like. The same recorded information may be used matched with different memory stores to select mosaic elements such as coloured tiles to enable the representation to be reproduced in any desired medium, for example an architectural mosaic.

60 Because my invention makes possible the preparation of patterns quickly and simply, and because those patterns, for example in the form of a recorded program, may be used directly to control the subsequent production of the desired representation, considerable flexibility is achieved. Thus production can be switched from one pattern to another quickly as demand dictates and programs recorded speculatively against the 65 possibility of future use. One-off production of patterns becomes much more economical, so that a customer may for example have an embroidery pattern made specifically to meet his personal requirement.

70 The original representation to be copied need not be art work designed for the purpose; pictorial and other visual matter of all types may be used, including photographs, paintings, drawings and abstract patterns and designs. Designs with a limited life or a minority taste or of a topical nature may be set up quickly and economically and it is not necessary to carry out a long production run to cover the cost of the preparation of the required pattern.

110 CLAIMS.

1. Apparatus for the production of patterns, comprising an electronic visual image sensor for scanning a representation of a desired design and providing a sequence of intensity signals for each of a multiplicity of points of the representation, means for converting the intensity signals to digital form and means for displaying the resulting sequence of digital signals.

115 2. Apparatus as claimed in claim 1, wherein the visual image sensor is designed to scan the representation through each of a plurality of primary colour filters.

120 3. Apparatus as claimed in claim 2, having also a gamma correction unit for balancing the responses from the scans conducted through the different filters.

125 4. Apparatus as claimed in any preceding claim, wherein the signal-display means is a printer, a video monitor or a visual display unit.

5. Apparatus as claimed in any preceding claim, having means for recording the sequence of digital signals.
6. Apparatus as claimed in any preceding claim,
5 having means for displaying and modifying the signals.
7. Apparatus as claimed in claim 5 or 6, having a computer programmed to control the recording of the signals and/or the modifying of the signals.
- 10 8. Apparatus for the production of patterns, which apparatus is substantially as hereinbefore described with reference to the accompanying drawing.
- 15 9. A method of producing a design or representation made up of a multiplicity of discrete differing units, comprising producing a pattern using apparatus as claimed in any preceding claim and using the pattern to produce the desired design or representation.
- 20 10. A method as claimed in claim 9, wherein the pattern is used to instruct a computer which controls the operation of a machine designed to produce the desired design or representation.
- 25 11. A method as claimed in claim 10, wherein said machine is an embroidery or knitting machine.

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